

VU Research Portal

Towards an improved knowledge capacity of cities. The case of Rotterdam

van Geenhuizen, M.; Nijkamp, P.

1997

document version

Early version, also known as pre-print

[Link to publication in VU Research Portal](#)

citation for published version (APA)

van Geenhuizen, M., & Nijkamp, P. (1997). *Towards an improved knowledge capacity of cities. The case of Rotterdam*. (Research Memorandum; No. 1997-14). Faculty of Economics and Business Administration.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:

vuresearchportal.ub@vu.nl

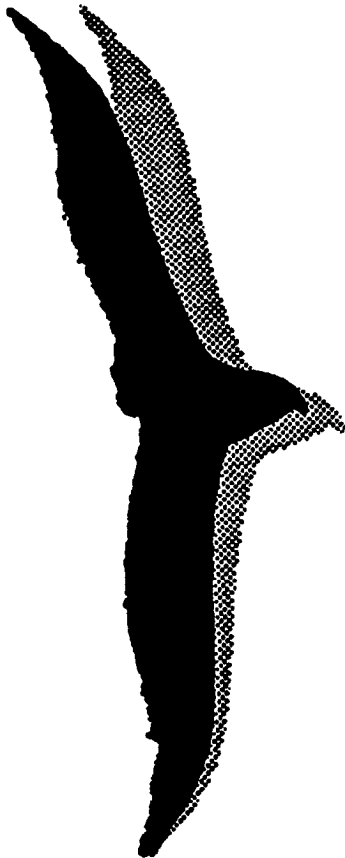
Serie research memoranda

Towards an improved knowledge capacity of cities:
The case of Rotterdam

Marina van Ceenhuiten
Peter Nijkamp

Research Memorandum 1997-14

February 1997



/a/l/e/r/t/

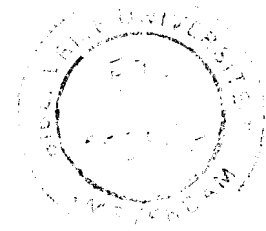
applied
labour
economics
research
team



**TOWARDS AN IMPROVED KNOWLEDGE CAPACITY OF CITIES:
THE CASE OF ROTTERDAM**

Marina van Geenhuizen*
Peter Nijkamp**

FEBRUARY 1997



* Delft University of Technology, School of System Engineering, Policy Analysis and Management. Jaffalaan 5, 2628 BX DELFT, NL. Tel: 31-15 2786729, Fax: 31-15 2783422.

** Free University of Amsterdam, Department of Regional Economics.

Abstract

In the past decades, the economic base of cities in advanced economies has shifted to a dominance of knowledge-based activities. Therefore, knowledge needs to be treated in urban policy as an important source of economic power and welfare. It is noteworthy that despite its importance, the urban knowledge capacity has seldom been investigated in an integrative way, including both creation and use of knowledge. First, this paper explores the urban knowledge capacity in a conceptual sense. It then turns to an empirical exploration, by using the city of Rotterdam in the Netherlands as an example. Both corporate managers and urban politicians and planners are facing an increased uncertainty leading to a need for various new knowledge. A major challenge is to establish institutional structures that preserve open learning and link various policy fields with each other. The paper concludes with a discussion of important lines of future research and policy aimed at improving the urban knowledge capacity, including an evaluation framework for urban policy.

1. Introduction

European cities are increasingly losing the protection provided by national borders. Vanishing borders mean the opening of regional economies to new networks and new social and economic influences, introducing an increased competition between cities (cf. Cheshire and Gordon 1995). Such a competition may imply the increase of regional disparities in employment levels and welfare. **At** the same time, there is a growing awareness of the environmental challenge and needs for a sustainable urban development (cf. Geenhuizen and Ratti 1997).

In advanced economies, the economic base of cities is being transformed from commodity-based activities in the production sector to knowledge-based activities in the knowledge sector or, broadly, the service-sector. Knowledge therefore, needs to be regarded and treated by urban planners and politicians as an important source of economic power (Knight 1995; OECD 1996). Accordingly, it is a major challenge for European cities to formulate policies for enhancing and valorizing their knowledge cultures and transforming knowledge into local economic development. Despite its importance, the urban knowledge capacity as *an integrative* concept - including the generation, attraction and use of knowledge, as well as various networking between the actors involved - has seldom been investigated empirically in relation to urban innovation.

Each city has a knowledge base. This knowledge base is much more than that contributed by formal processes of education and training. Knowledge in the urban economy comes also from accumulated experience, from suppliers, advisors and customers, from professional meetings and casual conversation, from local R&D and serendipidity, from migrant companies and intracompany transfer, from media, libraries, exhibitions, and data bases.

The size and structure of the knowledge capacity may be different between cities of a different size and socio-economic history. Although large cities continue to perform their role as knowledge centres, a new 'generation' of knowledge centres is emerging in recent times. The latter are usually smaller cities with strongly developed creativity functions (intellectual fields, as well as art and crafts) and good network links, such as with European high speed transport. These new knowledge centres are denoted as C-

cities, including communication, creativity and competence (Andersson 1991, Nijkamp et al. 1992). What these cities provide for firms is the best and latest knowledge and ideas, conditions to perform according to the highest standards, and access to resources of firms and organizations around the world (Kanter 1995). 'Such circumstances are particularly important for firms that are in the forefront of global competition.

First, the paper discusses the relevance of local knowledge sources and networks for innovative companies and innovative urban policy. Then, it turns to a conceptual exploration of the knowledge capacity by using an integrative approach. In an empirical part the city of Rotterdam in the Netherlands is explored as an example of urban economies in highly competitive fields with a need for innovative policy solutions. Attention is also given to what has been achieved in the Rotterdam region in terms of measures and new policy approaches. Following these empirical explorations, various future lines of research are discussed with a particular focus on the measurement of the urban knowledge capacity. The paper concludes with an outline of local knowledge policy and a set of critical success factors for such policy.

The paper does not offer the results of a thorough investigation of cities and their knowledge capacity. It merely tries to attract attention to this important research field and to develop various paths for future research.

2. Relevance of the Urban Knowledge Base

Companies are increasingly facing uncertainty of various kinds. The pervasive nature of new technologies (such as information and communication technology), shrinking technology life cycles and fierce global competition contribute all to this phenomenon. In order to reduce uncertainty, different kinds of knowledge are relevant, i.e. technical knowledge related to product and process innovation, commercial knowledge related to markets and finance, and management knowledge including internal and external relationships as well as human resources. In an entrepreneurial context, flows of knowledge encompass various different vehicles (Dosi et al. 1988; Geenhuizen 1994), namely:

human capital (ideas, expertise, skills and routines residing in employees and managers)

written language (data files, manuals, patents, scientific journals)

oral language (on-site instruction, audio representation)

hardware (devices, equipment, materials)

tacit or visual representation (transfer by observing, doing and imaging).

Companies derive new knowledge from a large number of sources. Internal sources are in-house R&D and practical experience in daily operations ('implicit' innovation). In the past decennia, a trend for an increased use of external sources has become evident (cf. OECD 1996). There are many different external sources, such as licences and new equipment (machinery), acquisition of small high-tech companies, networking in various configurations (including suppliers, customers, research institutes), outsourcing of R&D to consultancies and research institutes, human resource management (attracting new employees, retraining existing workforce), and informal contacts and networking.

The role of the city in advancing corporate innovation rests first and foremost in the *urban labour market*. In a European-wide study (Traxler et al. 1994) the labour market (actual skills and potential skills) ranked first among various urban attributes. It is important to note that the management of innovation involves more than acquiring new technology. It includes the ability of firms to transform the technology into new products and processes, to build the right industrial relations and to bring innovations to market (know-who). Thus, workers that operate new equipment or perform new laboratory experiments have to be found in the local (regional) labour market. The same holds for lower levels of management. A shortage of qualified and experienced personnel on various levels seems to be the most important threat faced by innovative firms (Geenhuizen and Nijkamp 1996). Whether there is a sufficient match between labour needs in the business world and supply in the local (regional) labour market depends on the ability of educational institutes to deliver sufficient numbers of educated persons on the desired level. It is also dependent upon the quality level of the urban housing market, particularly the ability to attract highly educated workforce and to prevent locally educated professionals to move away for housing reasons (Knight 1995).

A further important urban asset in corporate innovation is concerned with network attributes. These include the quality of telecommunication (representing immaterial network access) and specific (technology) links with local universities. With regard to the latter, various research results point to a preference for casual and short-term links between firms and universities, such as participation in courses (cf. Damman et al. 1997).

Just like corporate managers, urban politicians and decision-makers are facing an increased uncertainty. Various sources of uncertainty are largely beyond control of urban policy, such as macro-economic developments (e.g. global trends in competition), developments concerning European integration (fragmentation), and shifts in value systems and political power (Table 1). In addition, the urban system itself is a source of many uncertainties, such as autonomous processes in business growth and migration, and mechanisms underlying urban metabolism (relevant in a sustainability policy framework).

Table 1 Common sources of uncertainty in urban policy

Source	Main examples
1. Exogenous to urban system	<ul style="list-style-type: none"> . Macro-economic . Micro- and meso-economic (industrial organization) . Political power balance . Value System . Cohesion in society
2. Within urban system	<ul style="list-style-type: none"> . Autonomous developments of various kind
3. Policy aims	<ul style="list-style-type: none"> . Feasibility . Acceptability in society . Shifting goals and conditions (over time)
4. Policy instruments	<ul style="list-style-type: none"> . Effectiveness (time and costs) . Side-effects
5. Supporting knowledge (data)	<ul style="list-style-type: none"> . Validity in terms of accuracy and precision, coherence and coverage . Usefulness in terms of specific and generic applicability, up-to-datedness

There are also various sources of uncertainty in urban policy itself. These concern, for example, the feasibility of particular policy aims, the selection between competing policy instruments and their effectiveness in terms of time and costs, and the phenomenon of shifting policy goals and conditions.

Much uncertainty is recently emerging with regard to the carrying capacity of policy decisions in the field of sustainability aims. Notions of sustainable urban development are highly contestable (cf. Geenhuizen and Ratti ,1997; Haughton and Hunter 1994). A further source of uncertainty is the quality of the supporting knowledge (data) in policy design, such as in terms of validity and up-to-date character (Arts and Van Alphen 1996) (Table 1). The previous uncertainties in urban development and urban policy indicate that the city itself is a major local user of knowledge of various kind.

3. Knowledge Capacity as an Integrative Concept

Knowledge capacity can be defined as the capacity of urban actors to create new knowledge, attract knowledge from elsewhere, store, transfer, transform (for use) and use knowledge, and link various actors in the field with each other. Knowledge encompasses technology, but also managerial, marketing and policy knowledge, arts and (traditional) crafts. The urban knowledge capacity includes various essential activities (cf. Bureau Bartels 1996; Geenhuizen et al. 1997):

- *Management of (public) stocks of knowledge.* This includes providing access to archives, libraries, etc., and more importantly, the modernizing of skills of the resident population and labour force.
- *Creation of new knowledge.* This activity occurs well-structured and planned in universities, research institutes, and companies. However, new knowledge is also the result of unexpected events (meetings) and failure (sideways) in research experiments. There is a trend for interactive development of new knowledge in which users and creators work in close co-operation.

Networking to advance knowledge creation and flow. Networking is important in

the transfer of knowledge from creator to user, and in the creation of synergy between different actors and disciplines. Furthermore, networking is necessary to improve the integration of knowledge actors in the local community, and to connect local actors with global actors.

- *Transfer and transformation of knowledge.* There is a difference between basic knowledge and knowledge that can be applied, and between knowledge (vocabularies) of different disciplines. In order to smoothen transfer, knowledge is transformed in various ways, such as by change of vocabulary and transparent ways of presentation, etc.
- *Use of knowledge.* Major users of knowledge are companies and governments. It is increasingly recognized that economic growth based on the use of new knowledge is not only dependent upon the availability of this knowledge but also upon specific conditions in the market and production organization (Amable and Boyer 1995).
- *Transmission of knowledge.* This includes formal education such as by universities, higher educational institutes, schools of art, and company schools. It also includes training and elaboration of regional (local) crafts using informal channels.

There are many actors involved in the urban knowledge capacity: universities and higher educational institutes (including art schools), research institutes, consultancy firms, and think tanks, manufacturing and services firms, transfer institutes, brokers in network contacts and other intermediaries, and local governments. The performance of these actors is rather complex and difficult to understand, due to the following characteristics of the urban knowledge capacity:

multiple actor and multiple role situation
multi-faceted
multi-layer policy (management) framework.
changing setting of knowledge creation.

Actors involved in the urban knowledge capacity have often diverse (conflicting)

aims in relation to knowledge, such as improving the competitive edge (firms) and creation of high-tech jobs (local governments). In addition, particular actors perform different roles at the same time. Universities are gradually moving to a multiple role organization, with commercialization of knowledge aside from their traditional tasks in research and education.

The multi-faceted nature of urban knowledge capacity calls for a multidisciplinary approach. It includes aspects of science dynamics and serendipity, micro-economic behaviour of firms, sociology of clubs and informal networks, and economics of public finance. A further cause of complexity follows from the policy (or management) framework of urban knowledge being essentially multi-layered. The local municipality is important as it sets particular local conditions to the knowledge capacity, such as the availability of premises for companies and housing for particular income groups. At the same time, public and private actors at higher spatial scale levels influence the urban knowledge capacity to a considerable degree. For example, multinationals can decide to open or close down local laboratories, and national governments can decide to increase or cut down research budgets and fix the maximum number of students in particular faculties.

A final cause of complexity is the changing network setting of knowledge creation, with new benchmark criteria such as flexibility and response time. There is a shift from hierarchical, disciplinary and division of labour-based knowledge production to a mode in which research problems are set across disciplinary boundaries with a strong focus on application (Gibbons et al. 1994). In terms of organization, there is a larger number of actors involved (aside from universities, research centres) with an increased emphasis on teams (consortia) working on a temporary basis. As a consequence, there is a trend for delocalizing knowledge creation, particularly in situations in which there is no use of unique (locally fixed) research equipment.

Networking seems to be the most important activity to fully use the urban knowledge capacity. But there is a strong quality element involved. Not all networking is beneficial in terms of flexibility and open-mindedness. For example, tight local networks (often based on personal relationships) may preclude open learning of the actors involved, leading to a reduced local receptivity for new opportunities and innovative ideas, and a concomitant loss of competitiveness (Grabher 1993). This

situation seemed to have prevailed in the Ruhr Region, where traditional economic activities have been 'protected' for too long. In addition, in industrial relations one can observe a basic difference between horizontal coordination on the one hand and vertical integration (centralization) on the other hand (Saxenian 1994). The former enables much easier a flexible response to fast moving changes, while the latter causes much more rigidity between actors. These different models seem to explain the divergent developments of Silicon Valley and the Boston Area respectively. It is important to note that network cultures cannot be changed easily because they are essentially rooted in the socio-economic history and institutions of cities and regions.

4. The Case of Rotterdam

In recent years European ports are increasingly losing the protection provided by national governments. Measures of deregulation and harmonization within the European Union are leading to new forces of competition, creating win-lose situations. A further new factor is the opening of Eastern European markets. At the same time, sea and land transport are increasingly incorporated in complex networks of chains starting with raw material production and ending with delivery to customers, in which speed and flexibility are increasingly important. The globalization of markets and new systems of internal and external logistics have led to a new use of networks and nodes in new spatial configurations (Priemus et al. 1995; Ratti 1995).

Seaport activity determines transport and logistics in the Netherlands to a strong degree. From all inward bound goods 70% (tons) is transported by sea. Rotterdam has a leading position within the range of ports from Le Havre to Hamburg, with more than 40% of all throughput in this range of ports (Table 2). However, the leading position of Rotterdam is under pressure from competition by other Northwest European seaports and potentially by ports in Southern (Mediterranean) Europe. In recent years, the growth in overall throughput in Rotterdam seems to stagnate. A strong growth can be observed for the already large port of Hamburg (11%) and much smaller Wilhelmshaven (8%). A moderate growth (4%) can be observed for Rotterdam's main competitor Antwerp.

Table 2 Throughput of goods in major European ports

	Throughput (1995)		Change (1992-95)
	Abs. (mln tons)	Share (%)	(%)
<i>Le Havre-Hamburg Range</i>			
Rotterdam	294.3	40.0	0
Antwerp	108.1	14.7	+ 4.3
Hamburg	72.1	9.8	+10.8
Le Havre	53.8	7.3	- 1.3
Amsterdam	50.3	6.8	+ 2.4
Dunkirk	39.8	5.4	- 1.0
Wilhelmshaven	34.3	4.7	+ 8.2
Bremen	31.2	4.2	+ 1.3
Totals (a)	736.1	100	
<i>Other Ports</i>			
London	53.8	-	+15.3
Marseille	86.6	-	- 4.2
Genoa	46.7	-	+10.4

a. All ports, including smaller ones (not mentioned in the table).

Source: Rotterdam Port Authority 1996

Regarding class of good, containers are most relevant in view of the worldwide containerisation. With a share of almost 20% in total throughput in Rotterdam, containers are the second important class of good, following crude oil (33%). Although Rotterdam holds the largest share in container throughput in the Le Havre-Hamburg range (37%), competition seems to be fierce as witnessed by developments in the recent past (Table 3). Three ports in the Le Havre-Hamburg range have a significantly stronger growth than Rotterdam (16%), i.e. Le Havre (30%), Antwerp and Hamburg (both 27%). Moreover, two Southern European ports (much smaller than Rotterdam) increase in importance rapidly, i.e. La Spezia (close to Genoa in Italy) (58%) and Algeciras (Southern Spain) (48%). It needs to be investigated whether these ports focus on the same markets in Central Europe as Rotterdam.

Table 3 Throughput of containers in major European ports

	Throughput (1995)		Change (1992-95)
	Abs. (a)	Share (%)	(%)
<i>Le Havre-Hamburg Range</i>			
Rotterdam	4787	36.7	+16.0
Hamburg	2890	22.2	+27.4
Antwerp	2329	17.9	+26.9
Bremen	1524	11.7	+15.9
Le Havre	970	7.4	+30.0
Zeebrugge	528	4.1	+ 0.6
Totals	13028	100	
<i>Other Ports</i>			
Felixtowe	1924		+25.8
Algeciras	1155		+48.1
La Spezia	965	-	+57.7
Barcelona	689	-	+24.8

a. Number x 1000 TEUs (Twenty Feet-Equivalent-Units)

Source: Rotterdam Port Authority 1996

Given the same hinterland, the competitive strength of individual seaports is dependent upon many different factors. First, there are physical circumstances such as the quality of access from the sea, capacity of the seaports, proximity to large industrial complexes and metropolitan areas, and the quality of inland (waterway) connections. Regarding physical characteristics, Rotterdam ranks high in Europe (MVW 1996). In addition, various non-physical conditions play a role such as quality and productivity of seaport services, and regulation in view of social law, environmental protection and safety. Last but not least, there is the level of port tariffs. Decisions to land in Rotterdam are, of course, increasingly based upon price and efficiency (speed) over the *entire* chain involved. Two of the above factors call for attention in view of the competitive strength of Rotterdam (MVW 1995), i.e. congestion on the connecting inland road system and the cost/quality relation of port services.

With regard to dynamics in the Rotterdam economy, one can observe a somewhat

disappointing level of innovation in the business world (SEO 1994). The share of manufacturing firms active in R&D is relatively small (34%), compared with the larger region (province of South-Holland) (40%) and the national average (37%). The same holds for the focus of R&D on product innovation (61%, versus 69% and 65%) (Table 4). The position of Rotterdam is stronger with regard to innovation input in services, witness an emphasis on product innovation (83% of total R&D). However, when it comes to output patterns, one can observe a relatively weak position in services. New products/services account for 36% of turnover (the national average is 41%) (Geenhuizen 1996). These patterns indicate some failure (or missing links) in the knowledge capacity of Rotterdam, both in the availability (or accessibility) of knowledge and in the transformation of knowledge into commercial innovations. A similar impression is given by another indicator for dynamics of local economies, namely new firm formation (Table 5). Despite a relatively high birth rate (11.5), there is a relatively small birth surplus (5.3) in Rotterdam.

Various factors seem to contribute to the above situation (Bureau Bartels 1996). First, there is a small use of external knowledge by companies, meaning a weakly developed knowledge networking with research institutes and other companies in the region. With a predominantly national and international focus, the two universities (Delft University of Technology, Erasmus University) and other research institutes are weakly integrated in the regional economy. This can be regarded as a missed opportunity for local small and medium-sized industry. Second, there are many initiatives to increase the use of local knowledge, but these are mainly ad-hoc and fragmentary. Accordingly, there is a lack of transparency and coherence (focus) in the interface between knowledge creators and users.

As regards the future economic development of Rotterdam, the question arises whether the competitive position of the seaport needs to be further improved by building additional port facilities to accommodate growth. Within this framework, it needs to be emphasized that a number of 'benefits' from port facilities are falling back, for example, employment from port-related activities (Berg and Van Klink 1996; Boven and Machielse 1996). At the same time, value added seems to be relatively small in the region of Rotterdam. Apart from the petro-chemical industry, port activities have a focus on transit and storage. Value added from the port seems to be generated in a much larger area than

Rotterdam. This situation together with a shortage of indigenous dynamics in the local economy, call for innovative approaches to the future economic development of Rotterdam which may break up with traditional paths to a certain degree.

Table 4 Innovation input-indicators per firm (1992) (a)

Region	Manufacturing		Services	
	I	II	I	II
Rotterdam	34	61	9	83
Province of South-Holland	40	69	9	73
Reference values:				
Amsterdam	17	52	9	76
Maximum (province)	69	72	24	75
Minimum (province)	16	57	4	53
National average	37	65	10	69

a. I = Percentage share of firms active in R&D (internal/contracted out).
II = Percentage share of R&D with a focus on product-innovation.

Source: Adapted from SEO (1994)

Table 5 Firm birth and birth surplus (1993)

Region	Birth Rate (a)	Birth Surplus (b)
Rotterdam	11.5	5.3
Province of South-Holland	11.2	5.5
Reference values		
- Amsterdam	12.2	6.4
- Maximum (province)	18.1	10.1
- Minimum (province)	8.8	4.1
- National average	10.9	5.6

a. Newly established firms as a percentage of the stock of firms.

b. Newly established firms minus firms dissolved as a percentage of the stock of firms.

Source: Unified Chambers of Commerce (1994).

5. Results in Rotterdam

This section will discuss two important achievements in Rotterdam, one concerning the generation and use of new knowledge in the local economy (particularly port activities) and one concerning the use of new approaches in **identifying** innovative development directions in urban policy.

In order to increase coherence in urban knowledge initiatives, two **managing** (intermediary) organisations have recently been established, one with a *disciplinary* approach (transport technology) and an emphasis on links between research institutes and knowledge users in the business world (CTT 1996), and the other with a *regional* focus on knowledge transfer and use, and particularly education (KMR 1996). The former organisation has the task to initiate and co-ordinate various research projects concerning innovation in seaport activity. A good example is the study on potentials of an automated system for handling and moving sea containers, including unloading of ships, loading of trucks or trains, and moving the latter as automatically guided vehicles to an inland terminal. This study aims to increase efficiency of seaport services and to avoid using the road system. A second study identifies potentials for value added activities connected with the seaport.

There are various essential differences with research projects in the past. First, the present research projects are based upon public-private partnerships, meaning a joint financing by the national government (two-third) and companies (one-third). This construction implies a greater commitment of companies (demand driven) and also a greater concern to use the newly developed knowledge. A second point is that the present research projects have surpassed problems of individual companies and single transport modes. A further new development is the shift from reluctance in networking to a constructive atmosphere in the co-operation between universities, research institutes and transport/logistics companies.

In terms of new approaches in urban policy the following has been achieved. Within the local government a structure has been established aimed at an integrative approach with the participation of different departments. First activities have focused on the development of a strategic economic vision (10-15 years ahead) and concomitant interventions (investments, projects) (Boven and Machielse 1996). These activities have

delivered a set of scenarios, experience with the exploration of various uncertainty, and the identification of critical influences.

The new approach is a *process* approach to policy design and implementation. This approach has the advantage of intervention when unexpected developments occur. At the same time, it has been realized that when it comes to the translation of scenario thinking and process approaches into operational urban policy, there is the danger of falling back on fixed paradigms, old success stories and well-known networks. It can be concluded that first important steps have been taken in developing an innovative urban policy. New ways need to be found in which the local government as a learning organization can reap the fruits of these first steps.

6. Contours of Future Research

Research on the urban knowledge capacity using an integrative approach is not entirely new. A conceptual framework and methodology have recently been established in a mainly qualitative analysis (Knight 1995) and mixed qualitative-quantitative analysis (Bureau Bartels 1996). However, future research needs a stronger emphasis on quantitative approaches, in order to sharpen the understanding of problems, to provide a quantitative basis for policy design and monitoring, and to support cross-national comparative analysis. The following lines for future research can be sketched, with an emphasis on the identification and measurement of the urban knowledge capacity (1 - 5) and methodologies in urban policy (6 - 7):

- (1) To develop and use a set of indicators to identify the knowledge capacity of cities with regard to actors, activities, and networks within the city and with other cities. In order to achieve in-depth insights, measurement of the urban knowledge capacity needs to follow a cross-comparative approach.
- (2) To explore the links between innovative behaviour of companies and characteristics of the knowledge capacity of the host cities.

- (3) To explore the links between innovative policies of local governments and characteristics of the knowledge capacity of their cities.
- (4) To identify labour market dynamics which are crucial in the knowledge capacity (matching of demand and supply, in- and out-migration of knowledge workers and knowledge companies).
- (5) To identify barriers to knowledge networking and to design action-oriented network policies to bridge these barriers (to be addressed to city governments).
- (6) To develop new methodologies in order to cope with uncertainty faced in urban policy, such as scenario analysis and simulation experiments. In addition, ways need to be found to translate the results of such approaches into operational practice of urban policy and planning.
- (7) To find ways in which local structures (including the government) become learning organizations, providing a seedbed for a coherent and permanent generation of innovative thinking and solutions.

A vital ingredient in research on knowledge capacity is the analysis of *barriers*. The numerous networking activities - such as the identification of knowledge demand and supply and the transfer of new knowledge to users - are conducive to many different obstacles (Charles and Howells 1992; Geenhuizen 1994; Kamann 1993; Williams and Gibson 1990). But also the creation of new networks and expansion of old ones are subject to this phenomenon (Håkansson 1988).

Many barriers in communication have a socio-cultural background and affect both creators and users. Language is far the most important barrier here, preventing an adequate (de)coding of messages. Language barriers include spoken, written and computer language, as well as the vocabulary used in communication between different disciplines and companies with different corporate cultures (Williams and Gibson 1990; Knight 1995). A further category of barriers is concerned with social group (class) differences, such as based upon educational and income divergencies. In these cases, access

to knowledge may be prevented by means of exclusive membership such as of schools and clubs. Various cities suffer from decreasing social cohesion connected with these barrier mechanisms.

7. Contours of an urban knowledge policy

Local policy in European cities is facing an extremely important and challenging task in the next coming years. With the increasing dominance of knowledge-based activities in the economy, there is an urgent need to formulate policies for enhancing and valorizing the local knowledge capacity. The following policy aims may be relevant:

- to define and understand the urban knowledge capacity
- in a self-diagnosis, to identify and understand barriers in knowledge networking
- to give explicit priority to improve the knowledge capacity
- to satisfy various conditions, such as to upgrade the image of knowledge in society, to promote local achievements toward the outside world
- to establish an institutional structure which guarantees a permanent and coherent use of the urban knowledge capacity and its improvement.

Dependent upon the precise problem diagnosis, various targeted policy measures may be developed. To mention a few examples:

- to prevent processes of downgrading (net migration loss of educated people and artists, and knowledge firms) by a targeted housing policy and favourable policies for local business
- to advance a better match between corporate needs for local training and local supply by a targeted educational program
- to advance creativity in the community (intellectual, crafts, art), by recognizing and developing talents (providing stipendia, awards, prizes, degrees, etc.) and by promoting 'permanent education'
- to advance networking, particularly where local institutional and disciplinary

barriers prevent spontaneous processes (support of meetings, creation of meeting places)

to establish think tanks in local government and link them with different policy fields and different stages in policy development.

Many of the above policy measures are not new for most municipalities. What is new, however, is the role of knowledge as a guiding principle in a large number of policy fields. For this reason, it would be wise to benefit from cross-national learning to be established upon standardized research and data on cities throughout Europe. In addition, the design of innovative policies may benefit from using the so-called Pentagon Prism, an evaluation framework which has demonstrated its validity in various European infrastructure policy analysis (Nijkamp 1996). It includes a systematic investigation into five necessary conditions (critical success factors) which are to be satisfied in order to make policy successful. With regard to urban knowledge policy, the conditions can be summarized as follows (Figure 1):

- Hard ware:* This is concerned with the ‘hard’ core of policy aims and instruments. The main question is whether policy and projects provide a sufficient solution for the problems at hand, in terms of coherence and impacts.
- *Org ware:* This is concerned with a sufficient coordination and management of policy initiatives. A major point of concern is the social acceptability of various measures.
- *Enviro ware:* This condition seems not critical with regard to negative impacts from urban knowledge policy. But there may be very positive impacts in the framework of urban sustainability goals, such as the generation of knowledge in order to improve urban energy efficiency, and to advance the application of ecological principles in urban housing and spatial planning.
- *Econ ware:* This is concerned with economic feasibility and financial standards, such as from cost-benefit analysis and cost-efficiency models, and (recently established) economic impact analysis.
- Info ware:* This is concerned with a sufficient use of advanced information (technology), including data systems, software, modelling and experiments, in

order to deal with uncertainty in an explicit and transparent way. It has also an important role in establishing an objective basis for selection in urban policy.

Insert Figure 1.

The above conditions underline the challenging tasks of urban policy in improving the knowledge capacity. The pivotal role of knowledge in competition between companies and cities calls for a high priority for such policy.

References

Amable, B. and R. Boyer (1995) Europe in the world technological competition. *Structural Change and Economic Dynamics* 6: 167-183.

Andersson, A.E. (1991) Creation, Innovation and Diffusion of Knowledge - General and Specific Economic Impacts. *Sistemi Urbani* 3: 5-28.

Arts, G.J.M. and H.J.M. van Alphen (1996) *Use of Knowledge in Spatial Planning* (in Dutch). Delft: Delftse Universitaire Pers.

Batten, D.F., Kobayashi and A.E. Andersson (1989) Knowledge, Nodes and Networks: An Analytical Perspective. In: Andersson, A.E., Batten, D.F. and C. Karlsson (eds) *Knowledge and Industrial Organization*. Berlin/Heidelberg: Springer, pp. 3 1-46.

Berg, L. van, and A. van Klink (1996) Beyond the limits of a Mainport (in Dutch). In: *Economisch-Statistische Berichten* 28-2-1996: 180-1 84.

Bureau Bartels (1996) Improving Trust: A Strategy for Knowledge and Innovation for the region of Rotterdam (in Dutch). Utrecht: Bureau Bartels.

Boven, J. van, and K. Machielse (1996) Dealing with uncertainty in policy (in Dutch). In: Boekema, F. Kamann, D.J.F. and W. de Graaff (eds) *Local Economic Policy. New ideas in spatial research in the Netherlands*. Gronngen: Geo Pers. pp. 91-109.

Charles, D. and J. Howells (1992) *Technology Transfer in Europe, Public and Private Networks*. London: Belhaven Press.

Cheshire, P. and I. Gordon (1995) *Territorial Competition in an Integrating Europe. Local Impact and Public Policy*. Aldershot: Avebury.

CROW (1994) Towards a new research program on traffic, transport and infrastructure (in Dutch). Ede: Stichting CROW.

CTT (Foundation Centre for Transport Technology) (1996) Annual Report 1995 (in Dutch). Rotterdam: Foundation CTT.

Damman, M., Geenhuizen, M. van, and P. Nijkamp (1997) Innovative Behaviour in European Cities; The Relevance of Knowledge Networks. *Applied Geographic Studies* (in press).

Dosi, G., C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds) (1988) *Technical Change and Economic Theory*. London: Pinter Publishers.

Geenhuizen, M. van (1994) Barriers and Bridges in Technology Transfer: Perspectives for Border Regions. In: H. Coccossis and P. Nijkamp (eds) *Overcoming Isolation*. Berlin: Springer. pp. 103- 126.

Geenhuizen, M. van, P. Nijkamp (1996) What makes the local environment important for high tech small firms? In: Oakey, R. (ed) *High Technology Small Firms. Volume 2*. London: Paul Chapman. pp. 141-151.

Geenhuizen, M. van (1996) Mainport Rotterdam and Knowledge Capacity. *Proceedings of the European Regional Science Association 34th Congress*. Zurich: ETH Zurich (CD ROM published).

Geenhuizen, M. van, Nijkamp, P. and H. Rijckenberg (1997) Universities and Knowledge-Based Economic Growth: The Case of Delft. *GeoJournal* (in press).

Geenhuizen, M. van, and R. Ratti (1997) Managing Openness in Transport and regional Development: An Active Space Approach. In: Button, K., Nijkamp, P., and H. Priemus (eds) *Transport Networks in Europe*. London: Edward Elgar (in print).

Gibbons, M. et al. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage Publications.

Grabher, G. (ed) *The embedded firm. On the socioeconomics of industrial networks*. London: Routledge.

Hagedoorn, J. (1993) Strategic technology alliances and modes of, cooperation in high-technology industries. In: G. Grabher (ed) *The embedded firm. On the socioeconomics of industrial networks*. London: Routledge. pp. 116-137.

Håkansson, H. (1988) *Industrial Technological Development, A Network Approach*. London: Croom Helm.

Haughton G. and C. Hunter (1994) *Sustainable Cities*. London: Jessica Kingsley.

Kamann, D.J.F. (1993) Bottlenecks, Barriers and Networks of Actors. In: R. Ratti and S. Reichman (eds) *Theory and Practice of Transborder Cooperation*. Basel/Frankfurt am Main: Helbing & Lichtenhahn. pp. 65-101.

Kanter, R.M. (1995) *World Class. Thriving Locally in the Global Economy*. New York: Simon & Schuster.

KMR (Foundation Kennisinfrastuctuur Mainport Rotterdam) (1996) Annual Report 1995 (in Dutch). Rotterdam: KMR

Knight, R.V. (1995) Knowledge-based Development: Policy and Planning Implications for Cities. *Urban Studies* 32: 225-260.

MEZ (Department of Economic Affairs) (1995) *Knowledge in Action* (in Dutch). The Hague.

MVW (Department of Traffic and Transport) (1995) *Paper on Progress in Seaport Policy* (in Dutch). The Hague.

MVW (Department of Traffic and Transport) (1996) *An International Comparison of Infrastructures*. The Hague: SDU Publishers.

Nijkamp, P., G. van Oirschot and A. Oosterman (1992) Technopolis and Spatial Development. *TOPOS* 5: 93-106.

Nijkamp, P. Vleugel, J. Maggi, R. and I. Masser (1994) *Missing Networks in Europe*. Aldershot: Avebury.

Nijkamp, P. (1996) Policy and policy analysis: narrow margins versus broad missions (in Dutch). In: Nijkamp, P., Begeer, W and J. Berting (eds) *Complex decision making: A panoramic view*. The Hague: SDU publishers. pp. 129-146.

OECD (1996) *Science, Technology and Industry Outlook 1996*. Paris: OECD.

Priemus, H., Konings, J.W. and E. Kreuzberger (1995) *Nodes in Freight Transport: Typology and Dynamics* (in Dutch). Delft: Delftse Universitaire Pers.

Ratti, R. (1995) Dissolution of Borders and European Logistic Networks. In: Banister, D., Capello, R. and P. Nijkamp (eds) *European Transport and Communication Networks*. Sussex: John Wiley & Sons.

Rotterdam Port Authority Databank.

Saxenian, A. (1994) *Regional Advantage. Culture and Competition in Silicon Valley and Route 128*. Cambridge Mass.: Harvard University Press.

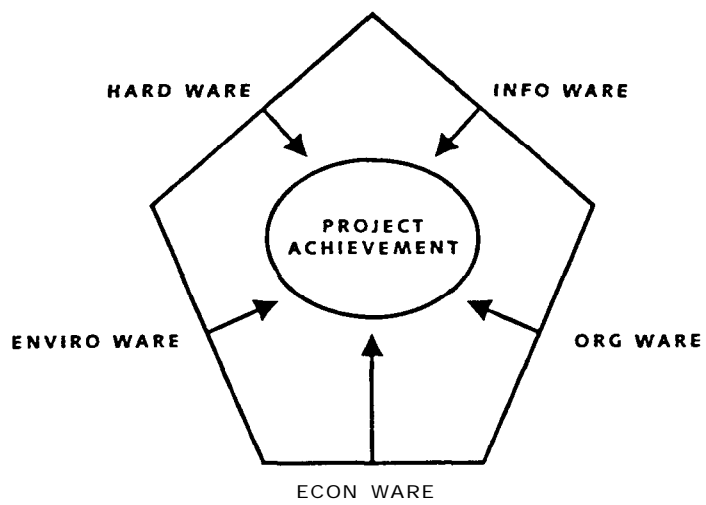
SEO (Foundation for Economic Research) (1994) *The Regional Dimension of Innovation in the Netherlands Manufacturing and Service Industry* (in 1992). Amsterdam: SEO.

Traxler, J., U. Schubert and P.M. Townroe (1994) R & D activities in companies and universities and their role in urban development. Vienna: Research Paper Vienna University of Economics and Business Administration.

Unified Chambers of Commerce (1994) Business Dynamics 1993 (in Dutch). Woerden.

Williams, F. and D.V. Gibson (1990) *Technology Transfer. A Communication Perspective*. Newbury Park: Sage.

Figure 1 **Critical success factors based on the Pentagon model**



Source: Nijkamp et al. 1994.